This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

EP 0045785

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3: F16K 31/383	A1	(11) International Publication Number: WO 81/02335 (43) International Publication Date: 20 August 1981 (20.08.81)

(21) International Application Number: PCT/US81/00155

(22) International Filing Date: 4 February 1981 (04.02.81)

(31) Priority Application Number: 121,101

(32) Priority Date: 13 February 1980 (13.02.80)

(33) Priority Country: US

(71) Applicant; and
(72) Inventor: GIBBS, Alan, H. [US/US]; 10700 Caribbean Boulevard, Miami, FL 33189 (US).

(74) Agent: MALIN, Eugene, F.; Malin & Haley, One Financial Plaza, Ste. 2400 Fort Lauderdale, FL 33394 (US).

(81) Designated States: BR, DE (European patent), FR (European patent), GB (European patent), JP, KP, SU.

Published
With international search report

(54) Title: A FLUID DEVICE

(57) Abstract

A fluid device driven solely by input fluid to reciprocate a driven member in the device. The device is readily attached to a normal or special fluid supply system. The device can produce a pulsating fluid output that may be used for cleaning, especially for cleaning around and between teeth, as well as for cleaning and massaging gums. The device includes a main fluid flow path between the inlet and the outlet to drive an actuating apparatus and to transfer most of the input fluid out through the outlet. The actuating apparatus includes a driven member (66), a control system, and a drive system. The drive system includes a fluid drive port and a biasing system (88) for providing the driving force to reciprocally drive the driven member (66) and for aiding cyclic movement of the driven member. The biasing system may be a compression air chamber (88) and the control system may be a drip valve system (79).

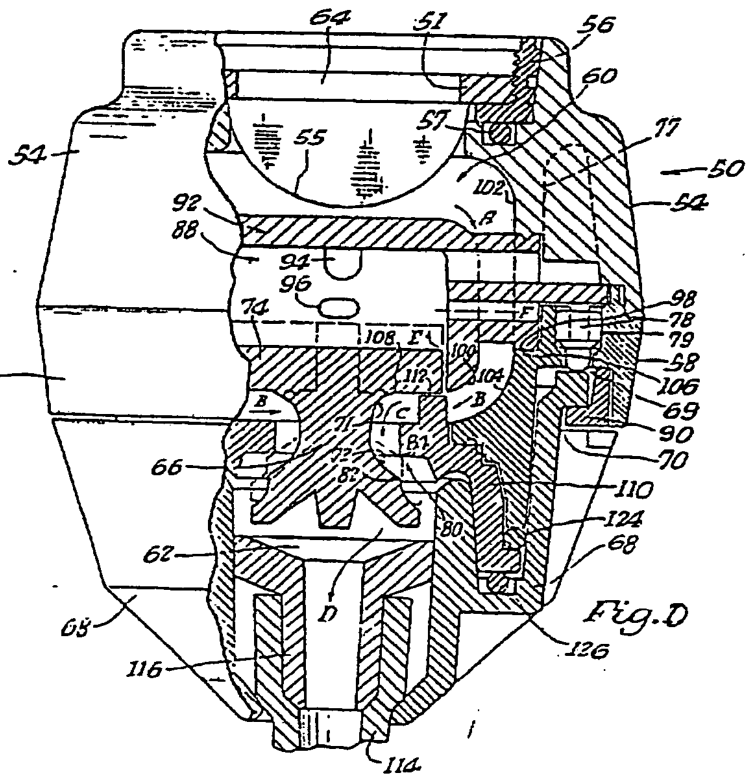


Fig. D

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BR	Brazil
CF	Central African Republic
CG	Congo
CH	Switzerland
CM	Cameroon
DE	Germany, Federal Republic of
DK	Denmark
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
HU	Hungary
JP	Japan
KP	Democratic People's Republic of Korea
LI	Liechtenstein
LU	Luxembourg
MC	Monaco
MG	Madagascar
MW	Malawi
NL	Netherlands
NO	Norway
RO	Romania
SE	Sweden
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
US	United States of America

A FLUID DEVICE

Background of the Invention

This invention relates to a new and improved fluid device that is self driven by its fluid supply and more particularly to a fluid device that reciprocally moves a driven member and directly discharges a major portion of the input fluid as a usable pulsating output fluid through its discharge outlet. The actuating apparatus includes the driven member, a drive system having a biasing system, and a control system that utilizes only a minor portion of the input fluid to trigger the cyclic movement of the driven member and to trigger each cycle of the cyclic movement of the driven member.

In the past, devices employing pulsating jets of water for oral hygiene have employed a small reservoir for the water and have used an electrical pump to discharge a stream of water at a suitable velocity against the gums and teeth of the user. Various rotary driven members have been used to create a pulsating output. Other disclosures have been suggested employing fluid driven reciprocating valves to indirectly discharge a pulsating stream of fluid. The applicant's prior device disclosed in U. S. Patent No. 3,499,440 and the prior art references of record cited therein, attempt to produce a pulsating fluid output stream. The 3,499,440 patent discloses a structure for discharging the pulsating fluid output through an intermediate piston chamber. The 3,499,440 patent does not disclose the use of an air biasing system to aid cyclic movement of a reciprocating driven member. The applicant herein discloses an air expansion chamber utilized as a biasing means. A great deal of the fluid passing through the applicant's prior art device was wasted through direct discharge and the discharged fluid was not usable for oral hygiene purposes. Further, the present invention as disclosed provides an extremely wide range of pulsation for the discharge output from less than one pulse per second to more than a hundred cycles per second and may reach four hundred or more cycles per second by increasing the size of the control means valve or decreasing the size of the control means valve cage in conjunction with moving the screw into the probe channel.

Summary of the Invention

The present invention relates to a new and improved fluid flow device which is continuously driven by the input fluid and discharges the major portion of the input fluid as a controlled pulsating fluid output. The device is readily attached to a normal or special fluid supply. The device is connectable to a fluid supply system having a discharge control valve. The device includes a housing and actuating apparatus. The housing includes an inlet and an outlet with a main fluid flow path therebetween. The main fluid flow path

BUREA
OMPI

includes a cavity between the fluid supply inlet and the outlet. The actuating apparatus creates the pulsating fluid output by a drive system, a driven member, and a control system. The main fluid flow path insures that the majority of the fluid input is discharged out through the outlet as a pulsating fluid output. The drive system includes a fluid flow device and a biasing system in the form of a compressible air chamber for providing the driving force to reciprocally drive the driven member and to aid in cyclic movement of the driven member. Only a small quantity of the input fluid is utilized in the control system to initiate during cyclic movement of the driven member and may even initiate each cycle of the repetitive cyclic movement of the driven member. The input fluid is discharged from a piston chamber that is connected to the portion of the air chamber as a control fluid for triggering each cycle of the cyclic movement of the actuating apparatus.

The fluid flow device or pulsating oral hygiene device is readily attached to a fluid supply or water supply downstream of a control valve, such as a household faucet. The pulsating oral hygiene device produces a pulsating, liquid discharge for cleaning teeth and massaging gums. The pulse rate and velocity are variable.

In one embodiment, the inlet is positioned on top of the body and the fluid flows down the outside portion of the housing or body to the actuating apparatus and directly out the outlet located at the bottom of the device; that is,

BUREAU
OMPI
WIPO
INTERNATIONAL

through the main path. A hose is connected to the outlet with a probe at the distal end. The probe may include a control valve to vary the pulse rate.

The driven member is located in the central portion of the body. This drive member includes a movable structure that is driven in a movement manner back and forth in a chamber in the body. The lower portion of the driven member includes a gating portion for creating the pulsating fluid output.

It is an object of this invention to provide a pulsating fluid discharge device driven solely by input fluid for discharging the major portion of the input fluid as a working, pulsating fluid output.

It is an object of this invention to provide a pulsating fluid discharge device driven solely by input fluid for cleaning around and between teeth as well as for cleaning and massaging gums.

It is another object of this invention to provide a fluid flow device having input and output and a main fluid path containing actuating apparatus that includes a driven member, fluid flow device, a biasing system, and a control apparatus for reciprocating the driven member.

It is another object of this invention to provide a fluid flow device having input and output and a main fluid path containing actuating apparatus that includes a driven member, fluid flow device, a biasing system, and a control apparatus to discharge a pulsating fluid and for utilizing only a minor portion of the fluid to initiate each cycle of movement.

BUREA
OMPI
WIPO

It is another object of the present invention to provide an inexpensive fluid driven oral hygiene device which may be used to properly clean teeth and stimulate gums by utilizing a major portion of the fluid stream.

It is another object of the present invention to provide an improved fluid driven reciprocally movable means having a gas compression chamber in the body of the device that allows a relatively small quantity of a liquid to move into the gas compression chamber and discharge vents as a triggering or control fluid to initiate cyclic movement.

It is a further object of the present invention to provide a fluid driven oral hygiene device which will direct a major portion of the incoming fluid against the user's teeth and gums as a pulsating stream that may be adapted to provide a non-pulsating fluid aerating device.

A further object of this invention is to provide a fluid driven fluid flow control device for providing pulsating fluid output with the fluid flow control device having adjustable control members to vary the rate of the pulsating fluid output.

It is another object of this invention to provide a fluid driven fluid flow control device having improved stability and efficiency.

It is another object of this invention to provide a fluid driven fluid flow control device having a pulsation and non-pulsing mode of operation.

It is another object of this invention to provide a fluid driven fluid flow control device that may be operated without an output pulse when converted for use as an aerating device.

An additional object of the present invention is to provide a pulsating fluid driven oral hygiene device which is self-starting upon application of water from a valved faucet.

In accordance with these and other objects which will be apparent hereinafter, the instant invention will now be described with particular reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 is an elevational view of the present invention, a partially broken away sectional view illustrating the fluid flow pulsating apparatus in a flow-through position with a phantom outline of the pulsating apparatus showing the gate closed. A proximal portion of an oral hygiene hose is illustrated.

Figure 2 is an elevational view of the present invention, partially broken away sectional view illustrating the fluid flow pulsating apparatus connected to a faucet and with an aerating apparatus in place.

Figure 3 is an illustration of a transverse cross-section taken along the line 2-2 of Figure 2.

Figure 4 is a partial view in cross-section view of Figure 3 taken along the line 3-3 of Figure 3.

Figure 5 is a scale bottom plan view of the upper housing of the present invention.

Figure 6 is an upright scale elevational cross-section of Figure 5 taken along lines 6-6.

Figure 7 is a reversed scale elevational view of the upper housing of Figure 6.

Figure 8A is a scale view of the section of Figure 5 taken along lines 8A-8A.

Figure 8B is a scale view of the section of Figure 8A taken along lines 8B-8B.

Figure 9 is a scale top plan view of the lower housing of the present invention.

Figure 10A is a scale cross-section of Figure 9 taken along lines 10A-10A.

Figure 10B is a scale cross-section of the section of Figure 10A taken along lines 10B-10B.

Figure 10C is a scale cross-section of the section of Figure 10A taken along lines 10C-10C.

Figure 10D is an enlarged cross-sectional view of the vent for discharge out a port through the lower housing of the present invention shown in Figures 9 and 10A.

Figure 11 is a scale right side elevation of Figure 9.

Figure 12 is a scale top plan view of a hose adapter for the present invention.

Figure 13 is a scale elevational cross-section of Figure 12 taken along lines 13-13.

Figure 14 is a scale elevational cross-section of Figure 12 taken along lines 14-14.

BUREAU
OMPI
WIPO
ATIONAL

Figure 15 is a scale elevational view of a hose adapter for the present invention shown in Figure 12.

Figure 16A is a scale bottom plan view of the hose adaptor of Figure 12.

Figure 16B is a section of Figure 12 taken along lines 16B-16B.

Figure 17 is a scale elevational view of the probe used with the present invention.

Figure 18 is a scale cross-sectional side view of the probe in Figure 18 showing a control valve screw movable into and out of the fluid flow path.

Figure 19A is a scale cross-sectional view of the probe in Figure 17 taken along lines 19A-19A.

Figure 19B is a scale cross-sectional view of the probe in Figure 17 taken along lines 19B-19B.

Figure 20 is a scale enlarged view of the threaded base of the probe in Figure 17.

Figure 21 is a scale elevation view of piston cylinder housing or upper piston cage of the present invention.

Figure 22 is a scale bottom view of the piston cylinder housing of Figure 21.

Figure 23 is a scale top plan view of the piston cylinder housing of Figure 21.

Figure 24 is a scale cross sectional view of the piston cylinder housing taken along lines 24-24 of Figure 22.

Figure 25 is a scale cross sectional view of the piston cylinder housing of Figure 23 taken along the lines 25-25.

Figure 26 is a scale top plan view of the lower piston cage of the present invention.

Figure 27 is a scale elevational view of the lower piston cage in Figure 26.

Figure 28 is a scale cross-section view of Figure 26 taken along lines 28-28.

Figure 29 is a scale top plan view of the hose collet used with the present invention.

Figure 30 is a scale cross-section of the hose collet of Figure 29 taken along lines 30-30.

Figure 31 is a scale elevational view of the pin or valve or metering member which is inserted in the vent shown in Figures 9 and 10A.

Figure 32 is a scale bottom plan view of the pin of Figure 31.

Figure 33 is a scale top plan view of the piston of the movable member of the present invention.

Figure 34 is a scale cross-sectional view of the piston in Figure 33 taken along lines 34-34.

Figure 35 is a scale top plan view of the driven member less the piston of the actuating apparatus of the present invention.

Figure 36 is a scale side view partially in cross-section of the driven member less the piston shown in Figure 35 taken along lines 36-36.

BUREAU OMPI WIPO

Figure 37 is a scale side elevational view of the probe, probe handle and a portion of the hose in cross-section.

Figure 38 is a scale top view of the hose adapter positioning portion or member.

Figure 39 is a cross-sectional side view taken along lines 39-39 and looks in the direction of the arrows in Figure 38.

Description of the Preferred Embodiment

Referring now in detail to the drawings, wherein an embodiment of the invention is shown, Figures 1, 3, and 4 illustrate the device in a pulsating mode, and Figure 2 illustrates the device in an aeration mode. Figures 5 through 39 are scale drawings of one working embodiment of the invention to fully disclose the device whose precise theoretrical operating characteristics may be undefined at this time.

Referring now in particular to Figure 1, the oral hygiene device or fluid flow device generally designated as numeral 50 is attachable to a household faucet such as 52 in Figure 2 having an output valve not shown. The fluid flow device 50 in Figures 1 and 2 includes an upper body member 54, shown in detail in Figures 5 through 7, connected to an adapter 56 with a gasket 57. Adapter 56 allows the device to be secured to the faucet 52. Other shaped adapters may be used. A washer 51 may be used to prevent leaks. An additional flat washer 53 may also be used with the washer 51 to further secure the device to the faucet 52 as shown in Figure 2. A filtering screen may be used to screen out foreign particles. A filtering screen is illustrated by number 55 in Figure 1.

The fluid flow device includes the upper body member 54 and a lower body member 58 that is connected to the upper body member 54 by a well known connecting means. The lower body member is shown in detail in Figures 9 through 11. The various elements of the fluid flow device may be welded together and are releasably connected by mating portions. The upper and lower body members 54 and 58 define an elongated cavity 60 for holding or containing the drive system or means, the driven member 66 and the control system or means. The driven member is shown in detail in Figures 33 through 36.

The fluid flow device 50 is therefore connectable to the discharge of a variable flow fluid supply system. The fluid supply system supplies fluid to power the device 50 in order to reciprocate the driven member 66 and to provide pulsating fluid output from the device through the exit or output adjacent numeral 62. The device 50 includes an actuating apparatus or actuating means or motor located in cavity 60. The actuating apparatus or means is powered by the fluid input or water from the fluid supply system to control the fluid to produce a reciprocating driven member 66 and to pulsate the fluid output of the greater portion of the fluid input. The body houses the actuating apparatus or means. The body includes an inlet adjacent numeral 64, an outlet at 62, central portion, and a main fluid path or conduit shown by arrows A, B, and C in Figure 1. Arrow D shows the path of the greater portion of fluid flowing out toward the exit 62. The central portion is fluidly connected to the inlet 64 by

UREAU
OMPI
WIPO
ATIONAL

the upper portion of the main fluid conduit. The outlet 62 is fluidly connected to the central portion by the lower portion of the main fluid conduit in order to discharge the greater portion of the fluid input. The actuating apparatus or motor is fluidly connected to the central portion of the device.

The actuating apparatus or means includes a drive means, a driven member 66 and a control means as shown in Figure 1. The driven member 66 includes, among other things, the fluid or fluidic surfaces 71 and 72. Surface 71 is used to drive the driven body of the driven member upward. The surface or portion 72 is used to drive the driven body of the driven member downward. The drive means includes, among other things, fluid flow means adjacent arrow B and biasing means. The fluid flow means is an orifice directing fluid against the driven member 66. The biasing means shown herein as an air chamber 76 is shown in Figures 2 and 5 and in Figures 1 and 6 by dashed lines 77. The biasing means includes the air chamber or chambers 76 and cavity 88. The biasing means operates on piston 74 of driven member 66. The control means illustrated by numeral 79 includes valve 78 shown in detail in Figures 31 and 32. The valve 78 is moved up by an upper portion 68'. The pulsating hose adapter 68 shown in Figures 12 through 16B to open up an initiating or trigger fluid path is shown by arrow F in Figure 1. The fluid flows in and around piston 74 as shown by arrow E. The outer circumference is spaced from the sides of the chamber 88. The small quantity of fluid exit out through the path designated by numbers 69 and 70. The exiting of the triggering fluid allows the pulsating means to begin a new cycle in the repetitive cyclic movement of the driven member 66.

The driven member 66 creates the pulsating output at exit 62. The driven member 66 includes a driven gating portion at 82 that is operatively connected adjacent the exit or outlet 62 to pulsate the fluid output before it moves out along a path shown by arrow D. The up and down movement of drive member 66 opens and closes the gate means 80 that includes the driven gate portion 82 and a base portion 84 on the lower piston cage member 110. The lower piston cage member 110 is shown in detail in Figures 26 through 28.

The driven member 66, the drive means and the control means are all operatively connected to power the cyclic movement of the driven member 66 and to pulsate the output fluid. Fluidic flow paths are provided to move the driven member 66 up and down in the body. The fluid flows from the orifice and flows out as indicated by arrow B from the circumscribed orifices. The fluid engages surface 71 of the driven member 66 to force it upward. The fluid from the orifice flows onto surface 72 when the driven member 66 is in an up position to move the driven member down. A greater portion of the fluid input passes by the driven member 66 and out through gate means 80 to the outlet 62. The biasing means aids in continuing the cyclic movement. The control means varies the forces on at least a portion of the driven member, that is, the piston 74, to continue the cyclic movement by providing the unbalancing force on

UREAU
OMPI
IONAL

the driven member to initiate or trigger each cycle. The control fluid or triggering fluid discharges out through control means 79. The control means 79 includes valve 78 shown in Figures 31 and 32 and the valve cage 78' shown in Figure 10D. A small quantity of triggering fluid from the control means then passes out of the device by moving from a point indicated by numeral 69 to a point indicated by numeral 70. The fluid will pass between the hose adapter 68 and the hose adapter positioning portion 90 or lug ring member 90 that is positioned between the lower body member 58 and the hose adapter. The lug ring member 90 shown in Figure 38 may be welded to the lower body member 58.

Gaskets 124 may be placed between the lower piston cage 110 and the bottom concentric portion of the lower body portion 58 to prevent leaks. Gasket 126 may be placed between a portion of the hose adapter 68 and the lower piston cage 110 to prevent leaks. The various parts of the device may be constructed of ABS plastic or other suitable material.

In the pulsating mode, see Figures 1, 3 and 4, the piston cylinder housing 92 shown in detail in Figures 21 through 25 is disposed within the defined elongated cavity 60 as illustrated in Figures 1, 2, and 4. The piston cylinder housing 92 includes a piston chamber 88, air chamber connection or conduit 94 and trigger fluid connection or passage 96. The cylinder housing 92 has a support portion 98. Further, the piston cylinder

BURI
CM
VIP

housing 92 has an outer fluidic surface 100 that provides a fluid path between the outer fluid surface 100 and the inside wall 102 of the upper body member 54 and the inside wall surface 104 of the lower body member 58. The support portion 98 is supported upon a concentric lip 106 of the lower body member 58.

The piston cylinder housing 92 allows the piston 74 to move therein and provide a biasing means to aid in cyclic movement of the driven member 66. The driven member 66 is fixedly connected to the piston 74. The piston 74 is bottomed out when the lower surface 108 contacts the upper surface portion 112 of the lower piston cage 110 shown in Figures 26 through 28.

The hose adapter 68 not only lifts valve member 78 to an open position as shown in Figure 1, but also connects the hose 114, preferably a urethane tubing having a length of about twenty-four inches, to the device. The tube 114 may include a proximal adapter member 116 also shown in Figures 29 and 30 that lies between the hose adapter 68 and the proximal end of the hose 114. The distal or other end of the hose 114 shown in Figure 37 includes a probe 118. The probe may be connected to the distal end of the hose 114 by a probe mount body 120 with a probe mount cover 122.

The probe shown in Figures 17 through 20 includes an elongated tapered nozzle 124 with a turned end portion 126. A screw means 128 is moveable into and out of the probe channel 130 to regulate the rate of the pulsating fluid jetting out of the end 126. The screw 128 may be used to control the rate of pulse when the supply fluid

BUREAU
OMPI
WIPO
INTERNATIONAL

from a faucet is at a generally steady pressure and quantity of flow. Screw 128 may be located in member 122 and 122' in order to control the rate of pulse. Screw 128 may also reduce the quantity of flow. The distal end of the probe includes a flange 132 and a screw meeting means 134. The screw means meets with the probe by the mount body 120 shown in Figure 37. The sizing and scale of the device may be as shown in Figures 17 through 20.

When the hose is mounted by the hose adapter 68, the hose adapter shown in Figures 12 through 16B includes an upper lifting portion 68'. The lifting portion 68' is an actuating device that lifts the valve 78 in order to initiate the control means to release fluid to control the cyclic movement of the device. The actuating member 68' is moved into position with the hose adapter 68. The hose adapter (see Figure 13) and the shelf portion 136 moves through openings 138 shown in Figure 38 in order that the support shelf 136 fits on top of the ring support member 140. It should be noted that support shelf 140 holds the hose adapter in position as shown in Figures 38, 39, and 13. The tolerances may even be made tighter than shown in the drawings to frictionally secure the hose adapter to the ring member 90.

It should be noted that the fluid driven fluid flow control device has a pulsating mode when lowered end of member 78 in Figure 31 is in contact with the top of member 68' in Figure 15 and a non-ulsating mode when the lower end of member 78 in Figure 31 is in contact with the top of member 68" in Figure 15.

BUREA
OMPI

Referring now to the lower housing member 58 shown in Figures 9, 10A, 10B, 10C, 10D, as well as Figure 11, the initiating fluid or triggering fluid that moves out of the upper piston cage 88 through openings 96, as shown by arrow F in the vent in Figure 1, will move through a tortuous path around wall portions 150 through cut down channels 152, as shown in Figure 9. The fluid will move through the tortuous path as shown by arrow G in Figure 9 and moves through slot 154 in Figure 10A into the valve cage 78'. When the valve member 78 is lifted up, the fluid will move out through channel 156 shown by arrow H in Figure 10D.

To convert the device to an aeration device, the hose adapter 68, gasket 126, hose 114, proximal adapter 116, and the probe 118 are removed from the device. As shown in Figure 2, the aeration holder 170 is connected to lug ring 90. The holder 170 is connected to member 172 which in turn is connected to damper 174 with aeration fixture 176. The damper 174 includes a water cavity 178 in which projection 180 of member 66 will move to fix the position of 66 as shown in Figure 2. The water will flow along path shown by arrow I to provide aerated water output by well known means.

The scale drawings are filed in this case because of the fluidic operation of the device whose mathematical formula and complete theory of operations is not known at this date.

BUREAU OMPI

The instant invention has been shown and described herein in what is considered to be the most practical and preferred embodiment. It is recognized, however, that departures may be made therefrom within the scope of the invention and that obvious modifications will occur to a person skilled in the art.

CLAIMS

1. An oral hygiene fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to reciprocate a driven member and produce a pulsating fluid output from the exit from the main fluid path through the device, comprising:

an actuating means connectable to the fluid supply system and powered by the input fluid for reciprocating a driven member and controlling the fluid output,

a housing means for housing said actuating means, said housing means including an inlet, an outlet fluidly connected to said inlet, a main fluid flow path between the inlet and outlet, and a triggering conduit fluidly connected to said inlet, said inlet connectable to the fluid supply system,

said actuating means connected to said main flow path and to said triggering conduit,

said actuating means includes a compression chamber in said housing means, a fluid orifice, said driven member and controling means,

said inlet connected directly to said orifice to fluid from said orifice to drive said driven member in reciprocating motion, said driven member including a portion connected for reciprocal cyclic movement in a portion of said gas compression chamber to provide a biasing force on said driven member to aid in cyclic movement of said driven member, said driven member includes a driven body, a fluid flow surface connected to said driven body and operatively connected to said orifice, and gating means connected to said driven body for providing pulsating fluid output,

said controlling means for initiating repetitive cyclic movement of said driven member, said controlling means connected to said triggering conduit for discharging of a relative small quantity of fluid from said device.

2. An oral hygiene fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to reciprocate a driven member and produce a pulsating fluid output from the exit from the main fluid path through the device as set forth in Claim 1, including:

a restraining means to prevent movement of said driven member,

an aerating means connectable downstream of said driven member to convert said device to an aerating device.

3. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device, comprising:

an actuating means connectable to the fluid supply system and powered by the input fluid for reciprocating a driven member and controlling the fluid output,

BUREA
OMPI
WIPO
NATI

a housing means for housing said actuating means, said housing means including an inlet, an outlet fluidly connected to said inlet, and a triggering conduit fluidly connected to said inlet, said inlet connectable to the fluid supply system,

said actuating means connected to said inlet, said outlet, and said triggering conduit,

said actuating means includes a means for driving said device, said driven member and controlling means,

said means for driving fluidly connected to said inlet, said means for driving includes fluid flow structure, and biasing means,

said fluid flow structure fluidly connected to said input and operatively connected adjacent said driven member, said fluid flow structure including means for providing the driving force to reciprocally drive the said driven member and for aiding cyclic movement of said driven member,

said biasing means operatively and fluidly connected to said fluid flow means and said driven member,

said biasing means for aiding cyclic movement of said driven member, said biasing means fluidly connected to said input,

said driven member includes a driven body, fluid flow surfaces connected to said driven body and operatively connected to said fluid flow structure, and a biasing driven portion connected to said driven body, said biasing driven portion operatively connected to said biasing means, said controlling means for varying the force on at least a portion of said driven body for initiating during each cycle the repetitive cyclic movement of said driven member, said controlling means connected to said triggering conduit for discharge of a quantity of fluid during movement of said driven member, said triggering conduit operatively connected to said driven member.

4. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 3, wherein:

said housing means including a gate seat positioned adjacent said outlet, and

said driven member includes a gating means including a gate seat, said gating means for reciprocating movement toward and away from said gate seat for producing a pulsating fluid output from said outlet.

5. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 4, including:

a means for providing a pulsating rate control by varying the rate of the pulsating fluid output from said outlet, said means for providing a pulsating rate control operatively connected to said actuating means.

BURE

6. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 4, wherein:

said means for providing a pulsating rate control is a variable stream reduction device connectable to said outlet.

7. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 4, wherein:

said controlling means includes an adjustable valve connected in said triggering conduit to vary the pulse rate of the pulsating output fluid.

8. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 3, wherein:

said fluid flow structure is an orifice directing fluid, said fluid flow surfaces of said driven body including means for providing the force to reciprocally drive the said driven member in both directions and for aiding cyclic movement of said driven member in both directions,

said biasing means is a compressable air chamber,

said biasing driven portion is a piston movable in a portion of said compressable air chamber, said fluid flow surfaces are vane surfaces,

said controlling means is a drip valve.

BUREAU OMPI WIPO INTERNATIONAL

9. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device, comprising:

an actuating means connectable to the fluid supply system and powered by the input fluid for reciprocating a driven member and controlling the fluid output,

a housing means for housing said actuating means, said housing means including an inlet and an outlet fluidly connected to said inlet, said inlet connectable to the fluid supply system,

said actuating means connected to said inlet and said outlet,

said actuating means includes means for driving said device, said driven member and control means,

said means for driving fluidly connected to said inlet, said means for driving includes fluid flow means, and biasing means,

said fluid flow structure fluidly connected to said input and operatively connected adjacent said driven member, said fluid flow structure includes means for providing the driving force to reciprocally drive the said driven member and for aiding cyclic movement of said driven member,

said biasing means operatively connected to said driven member for aiding cyclic movemement of said driven member,

BUREA
OMPI

said driven member includes a driven body, a fluid flow surface connected to said driven body operatively connected to said fluid flow structure, and a biasing driven portion connected to said driven body, said biasing driven portion connected to said biasing means,

said controlling means for varying the force on at least a portion of said driven body for initiating during each cycle the repetitive cyclic movement of said driven member.

10. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 9, wherein:

said housing means including a gate seat positioned adjacent said outlet, and

said driven member includes a gating means for reciprocating movement toward and away from said gate seat for producing a pulsating fluid output from said outlet.

11. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 10, including:

BUREAU
OMPI
WIPO
INTERNATIONAL

a means for providing pulsating rate control operatively connected to said actuating means for varying the rate of the pulsating fluid output from said outlet.

12. A fluid flow device connectable to the discharge of a fluid supply system for supplying fluid to the device in order to reciprocate a driven member and produce a fluid output from the device as set forth in Claim 11, including:

said compression chamber is a gas compression chamber.

13. What is shown and described herein.

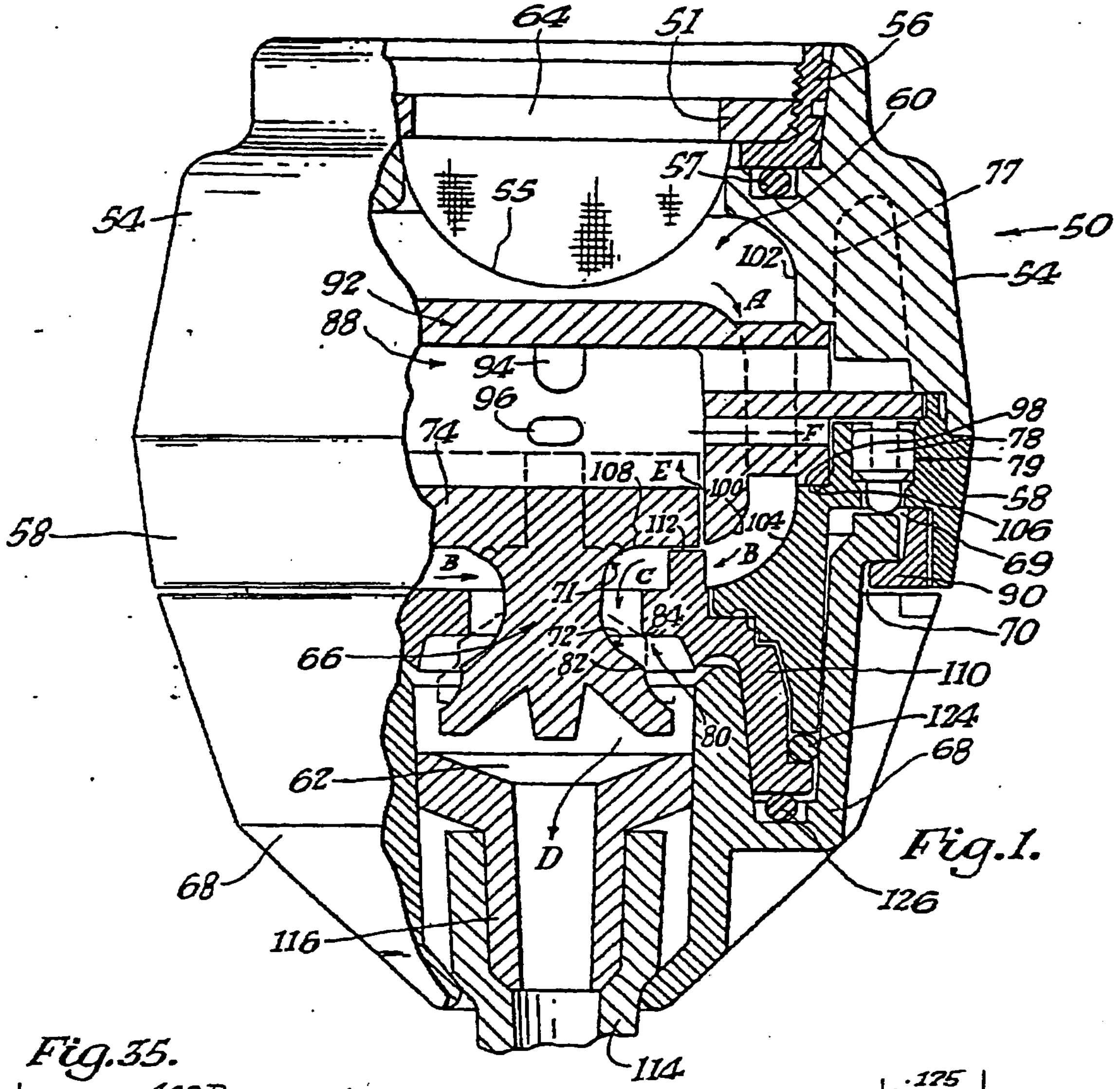
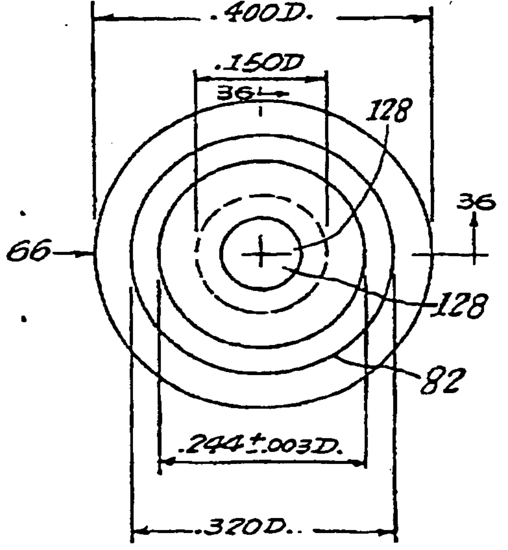


Fig.1.

Fig.35.



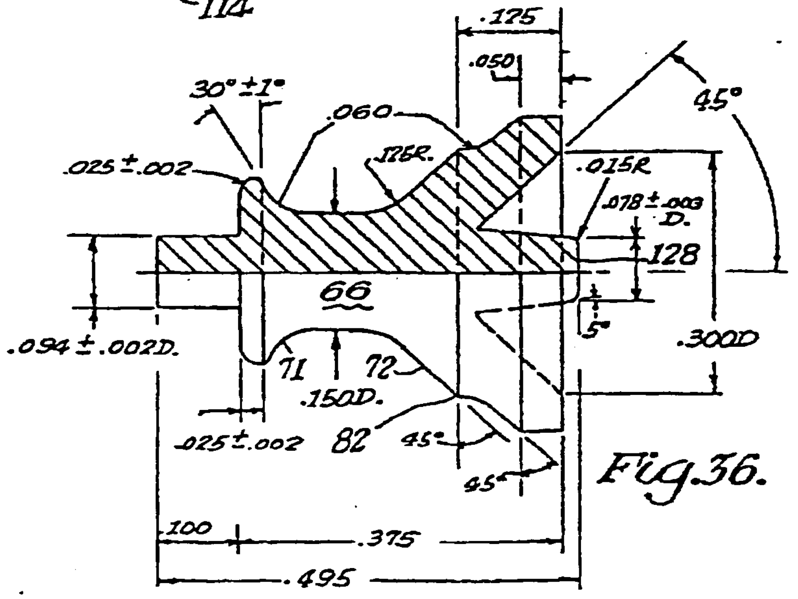


Fig.36.

BUREAU
OMPI
WIPO
INTERNATIONAL

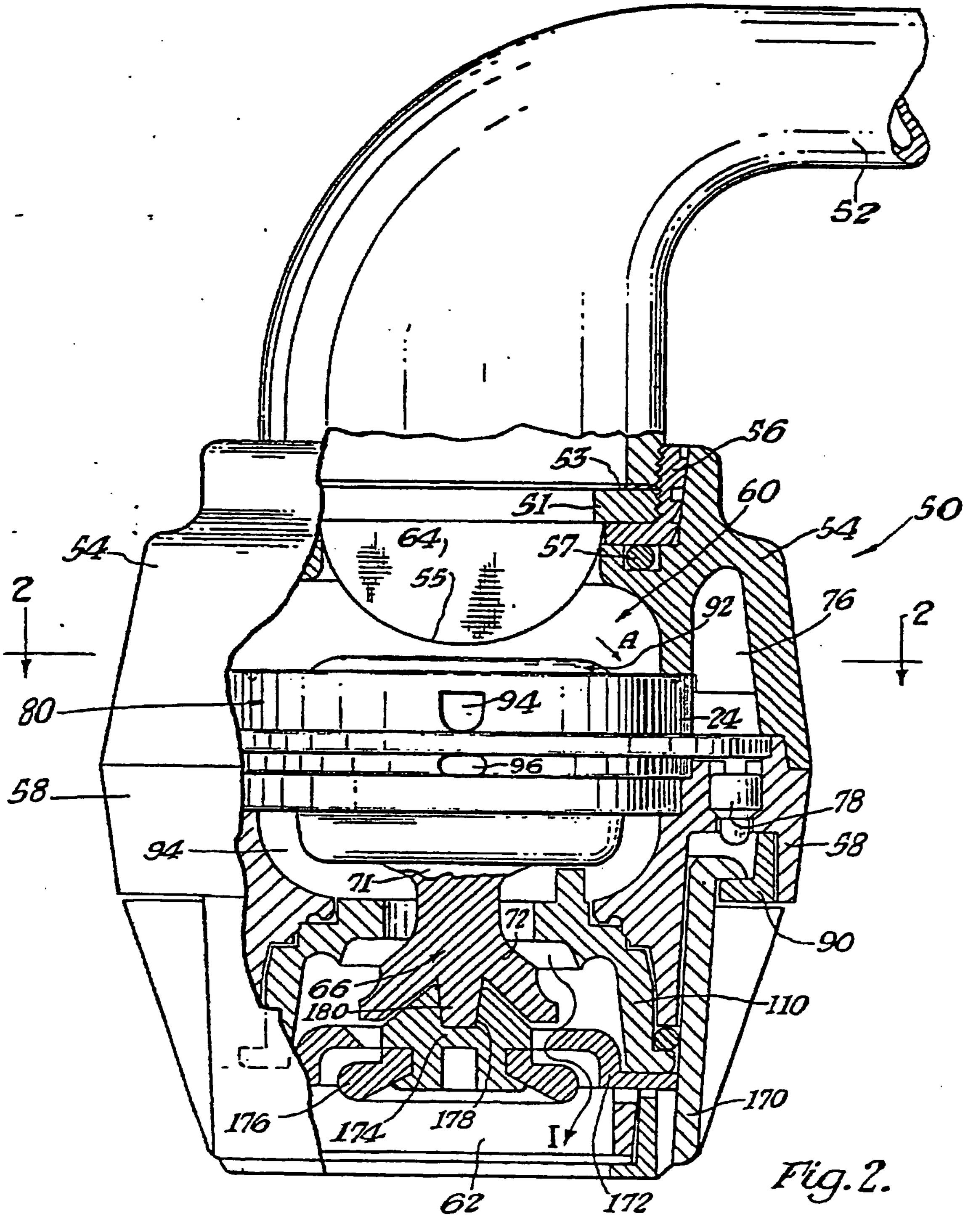

A
I

Fig.2.

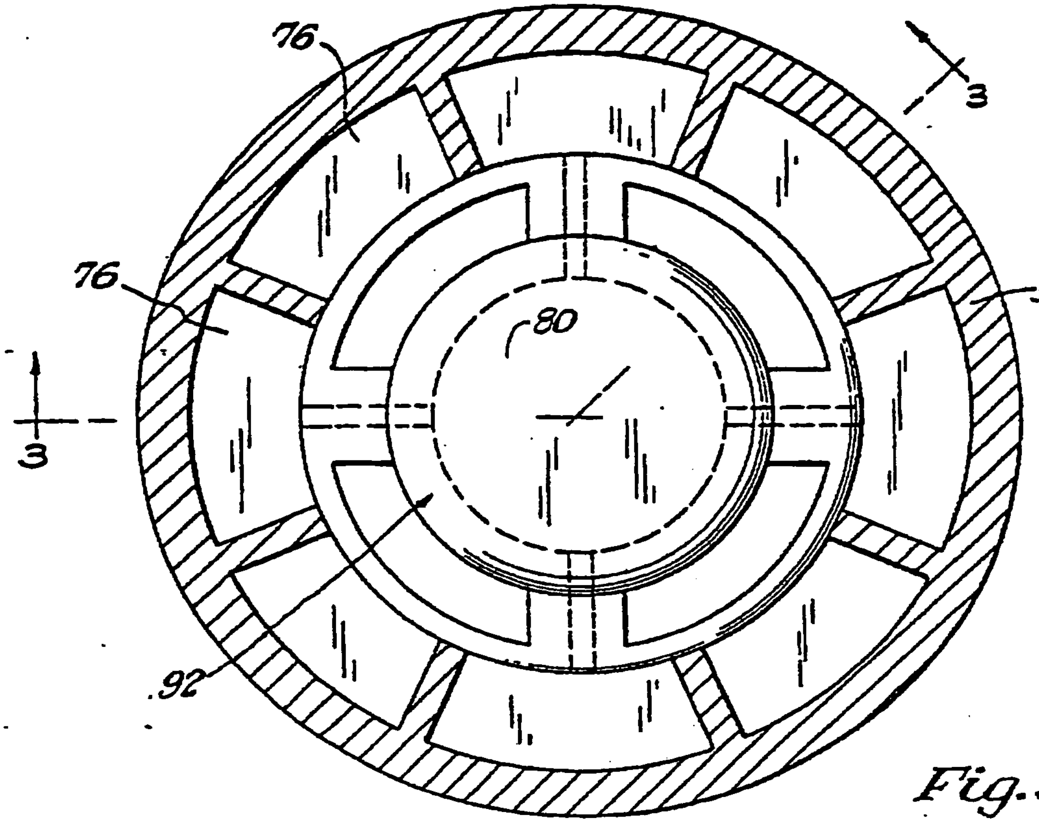


Fig.3.

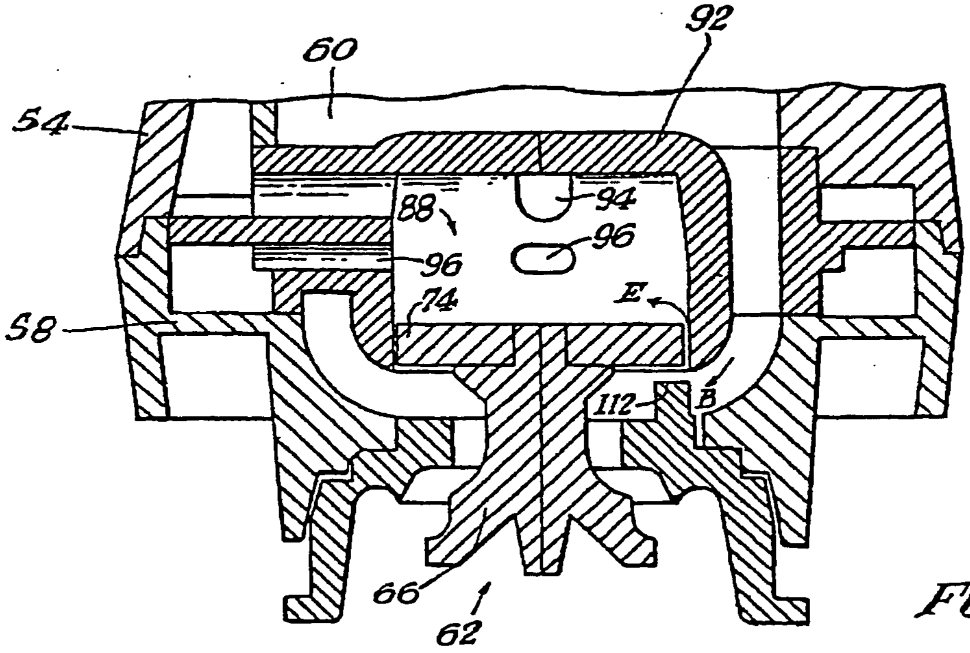


Fig.4.

BUREAU
OMPI
WIPO
INTERNATIONAL

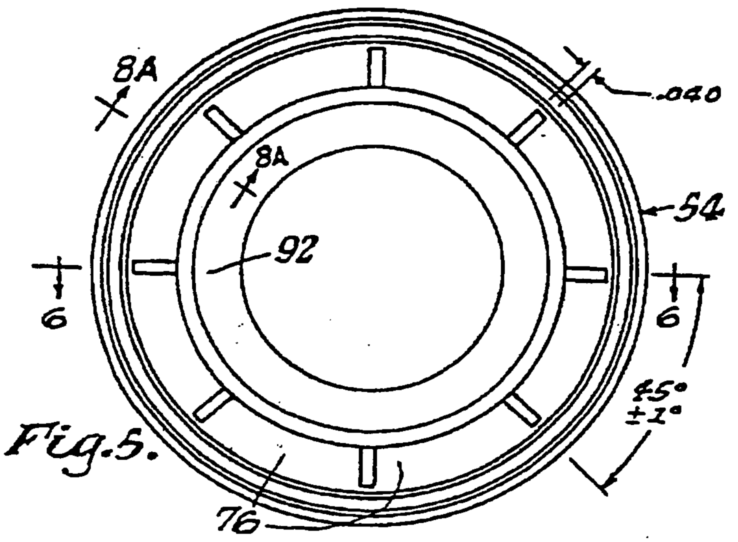


Fig.5.

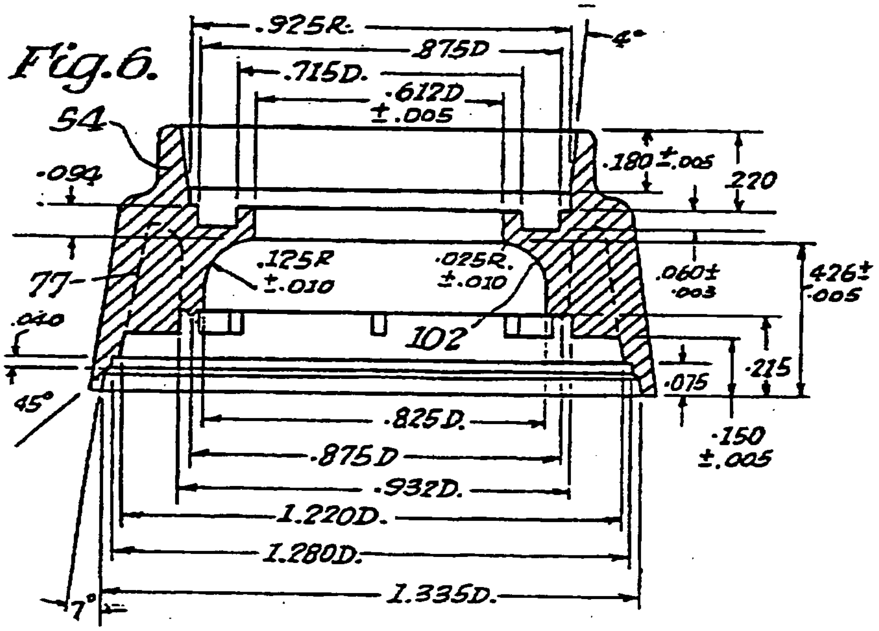


Fig.6.

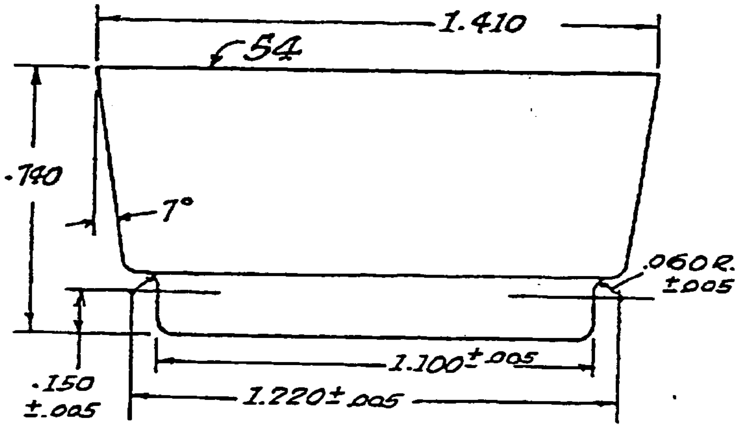


Fig.7.

BUREAU
OMPI
WIPO
INTERNATIONAL

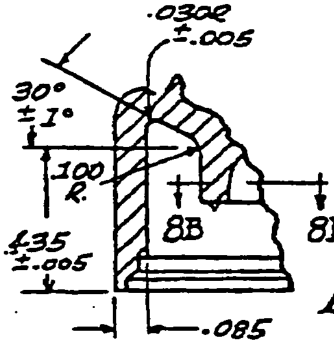


Fig.8A.

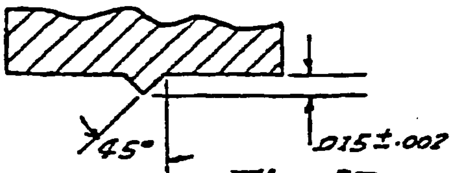
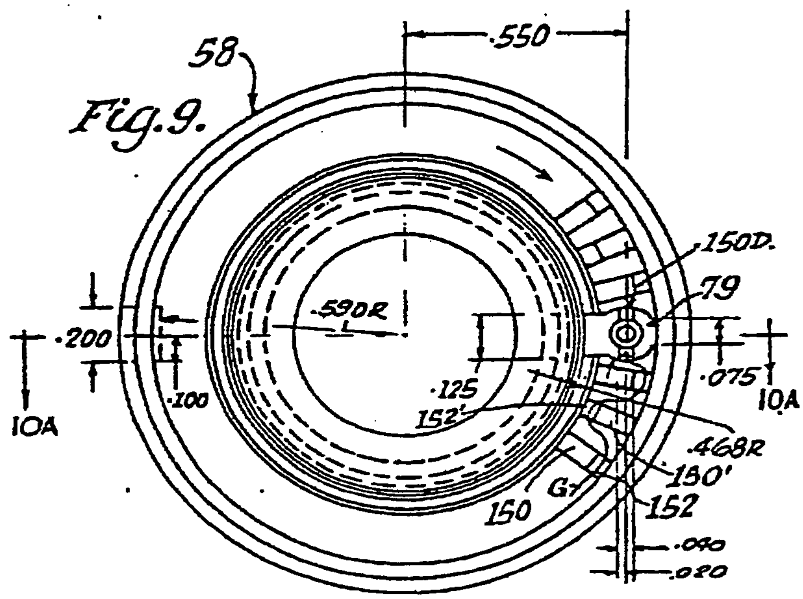


Fig.8B.

Fig.9.



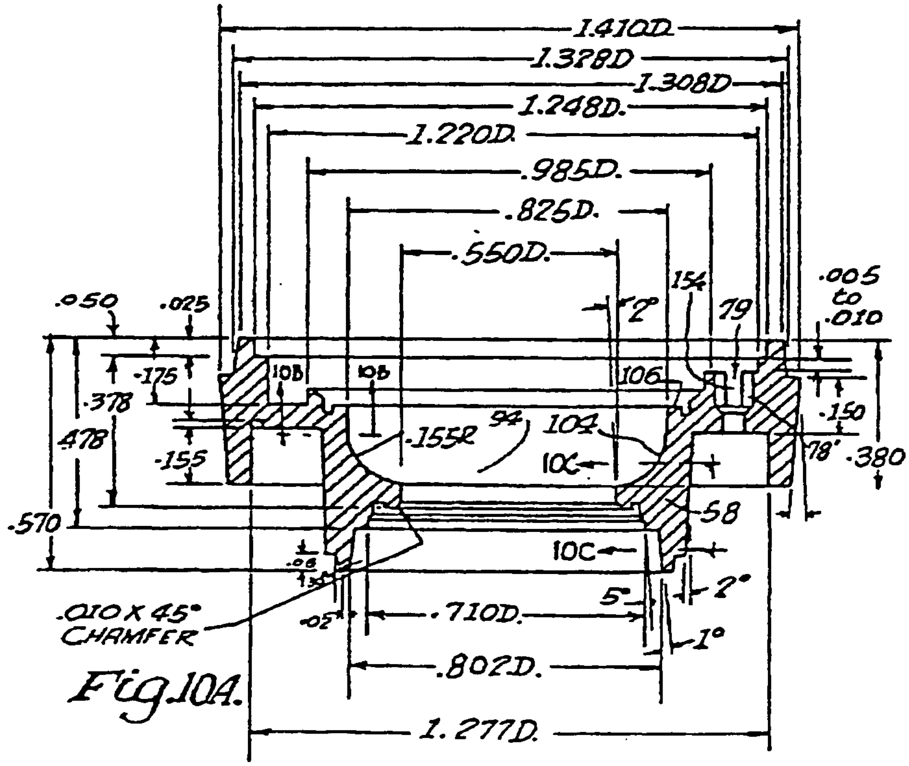


Fig.10A.

BUREAU
OMPI
WIPO
INTERNATIONAL

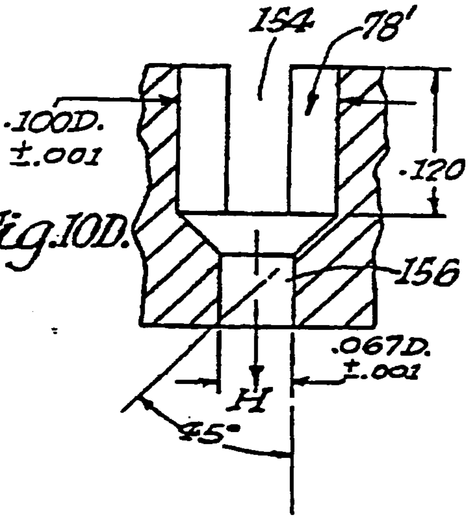


Fig.10D.

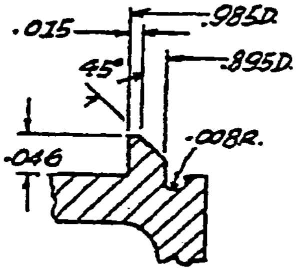


Fig.10B.

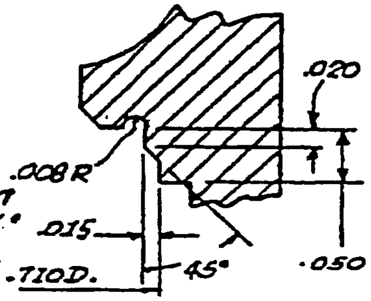
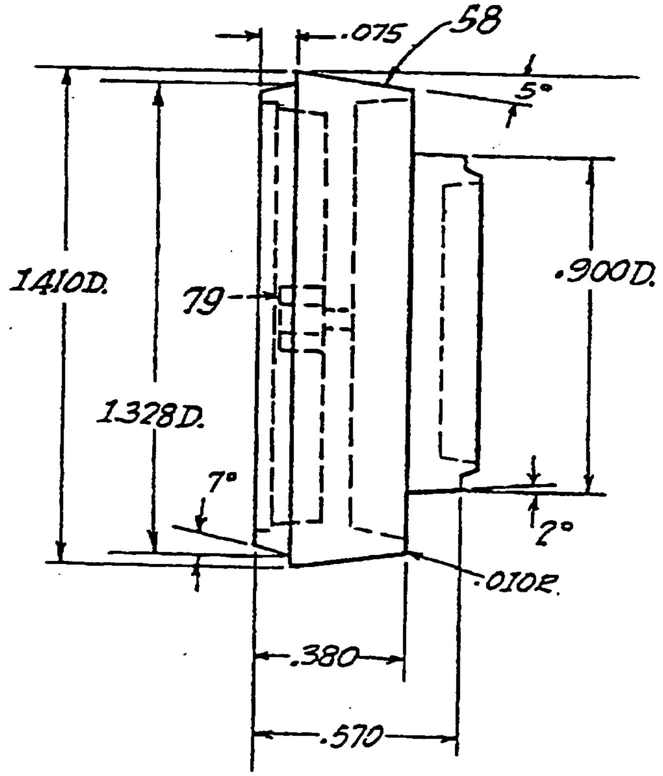


Fig.10C.

Fig.11.



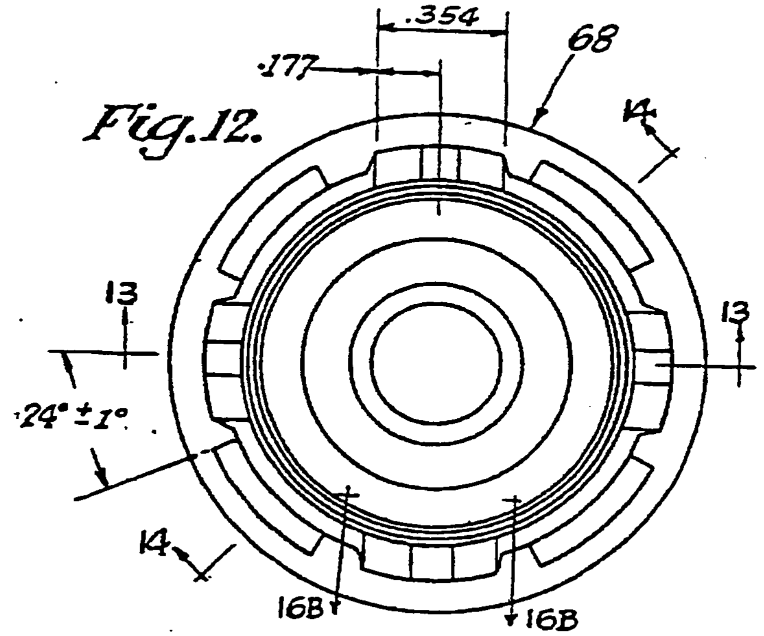


Fig.12.

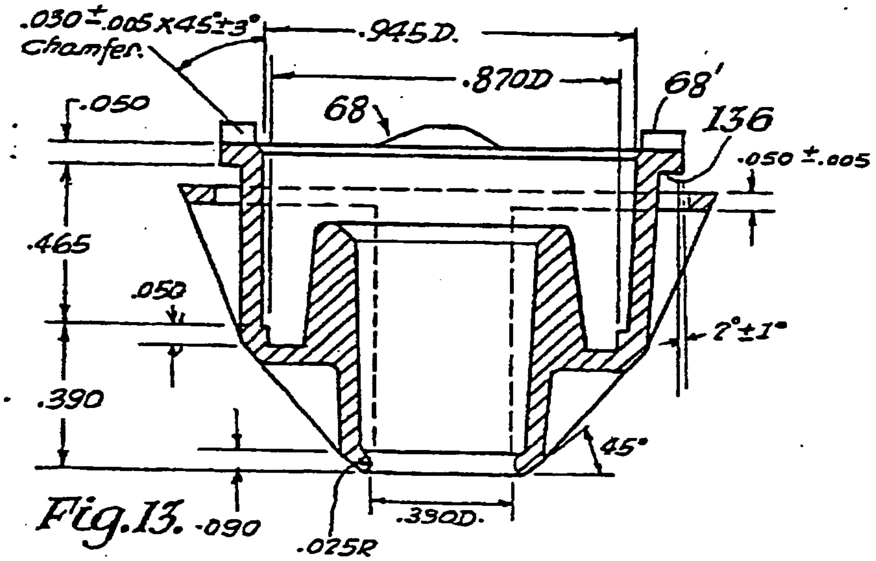


Fig.13.

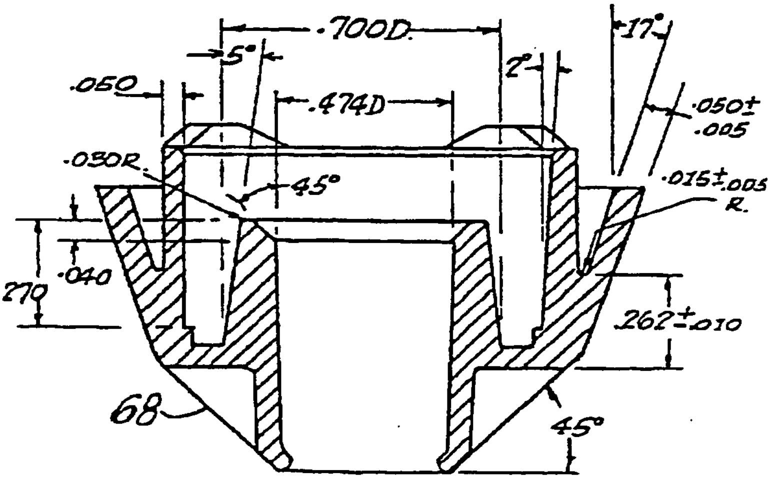


Fig.14.

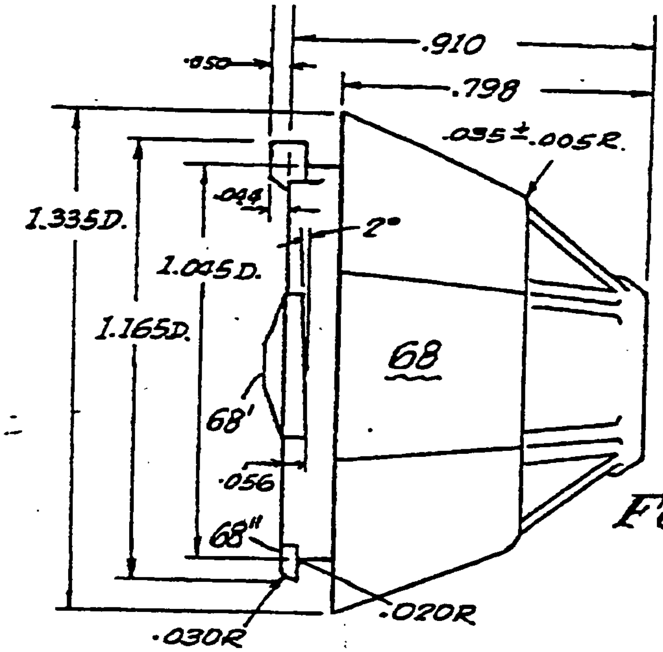
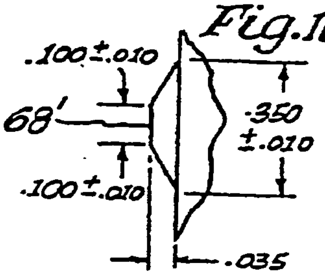


Fig.15.

Fig.16B.



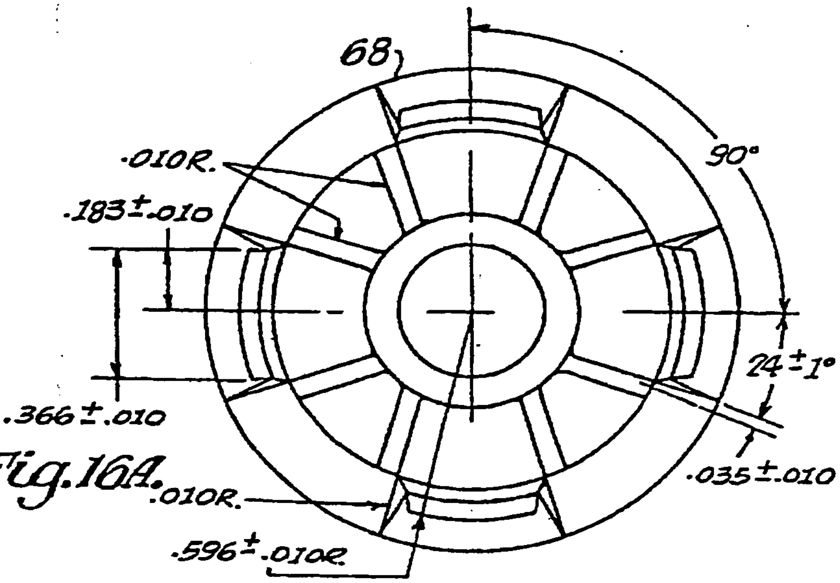
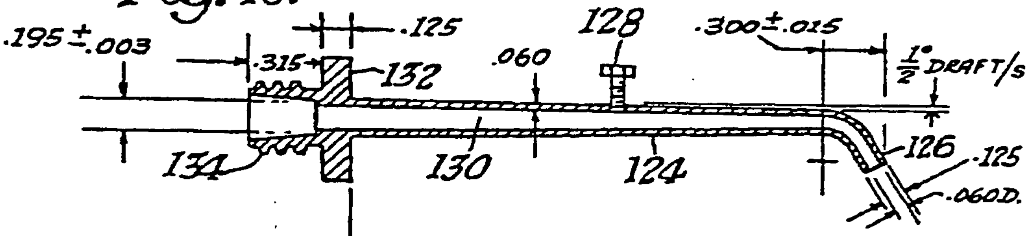


Fig.16A.

Fig. 18.



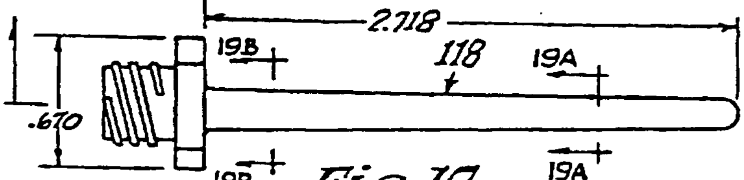


Fig.17.

BUREAU OMPI WIPO INTERNATIONAL

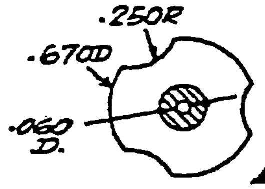
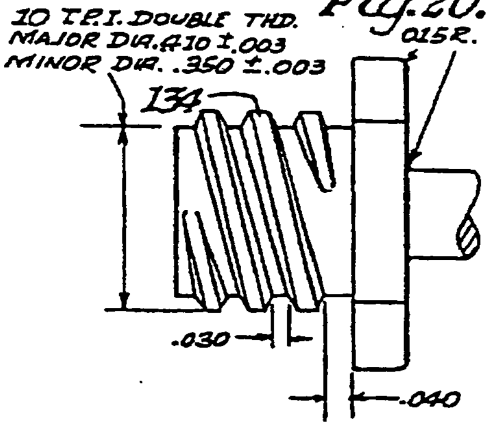


Fig.19A.

Fig.20.



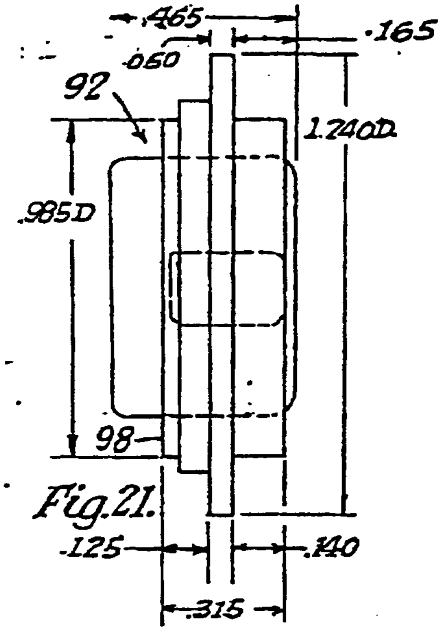
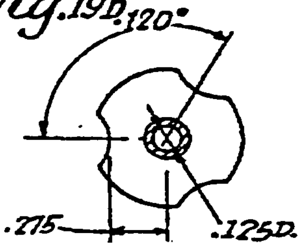


Fig.21.

Fig.19B.



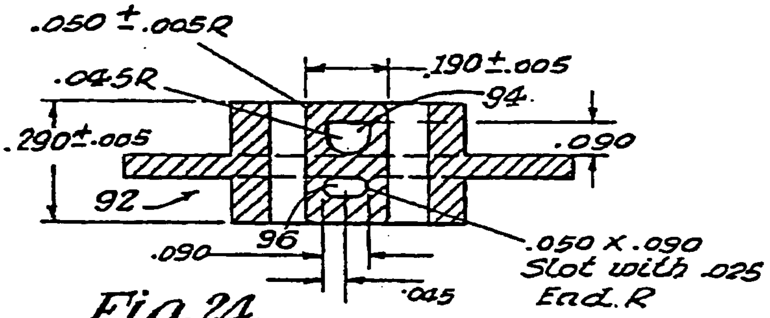


Fig.24.

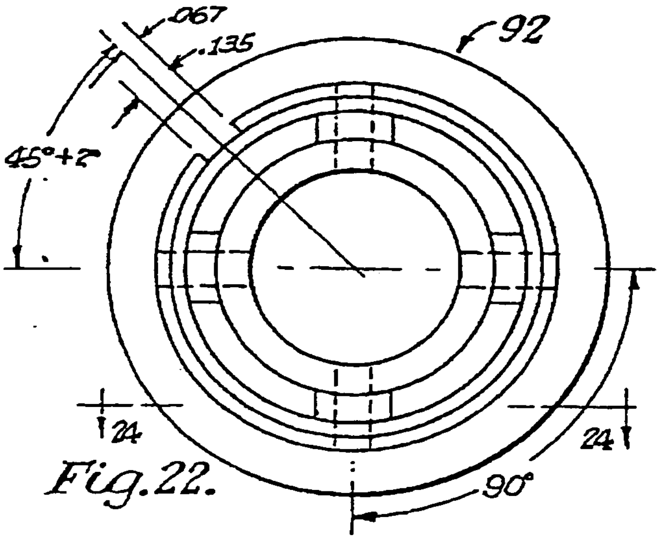


Fig.22.

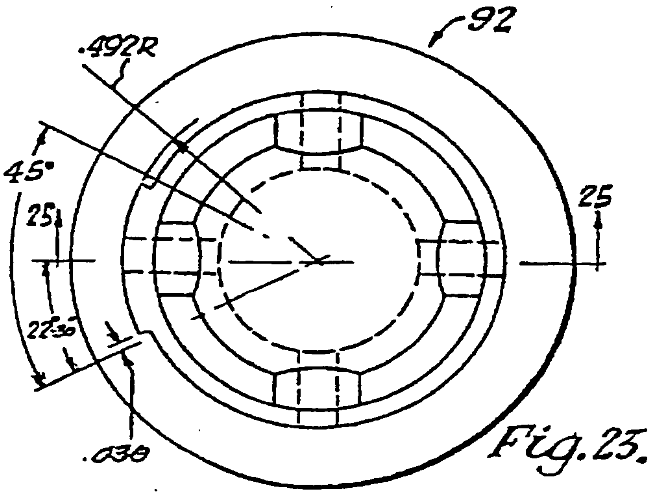


Fig.23.

BUREAU
OMPI
WIPO
INTERNATIONAL

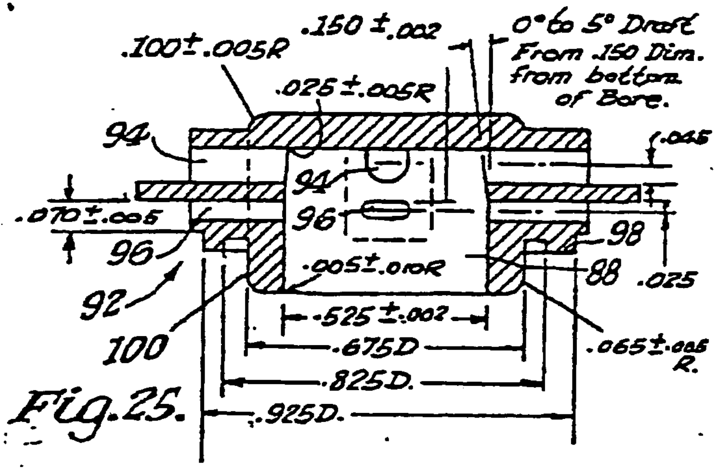


Fig.25.

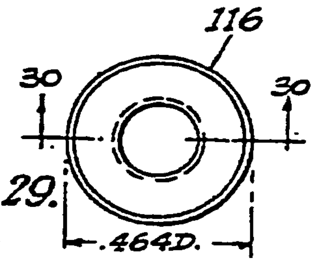


Fig.29.

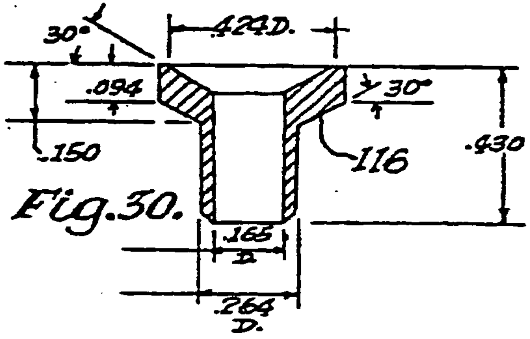


Fig.30.

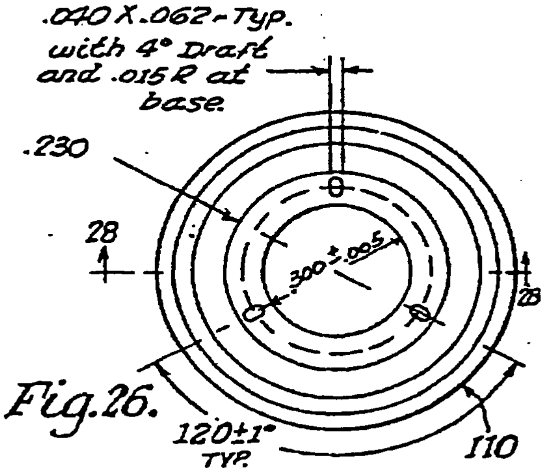


Fig.26.

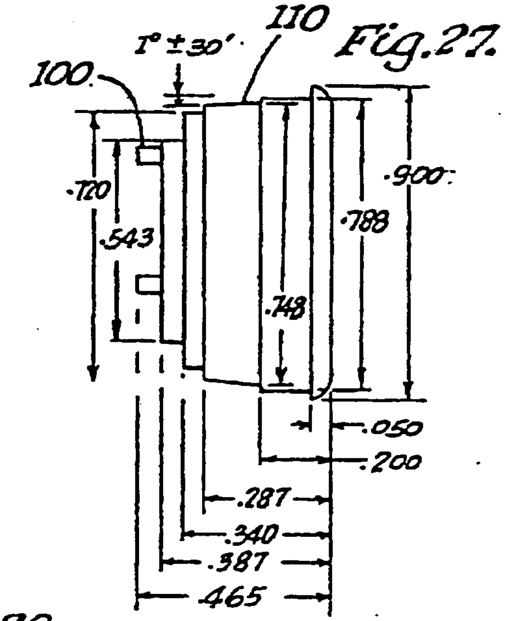


Fig.27.

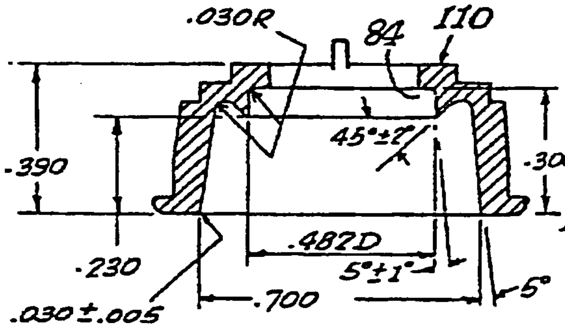


Fig.28.

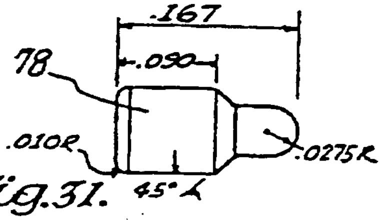


Fig.31.

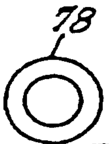


Fig.32.

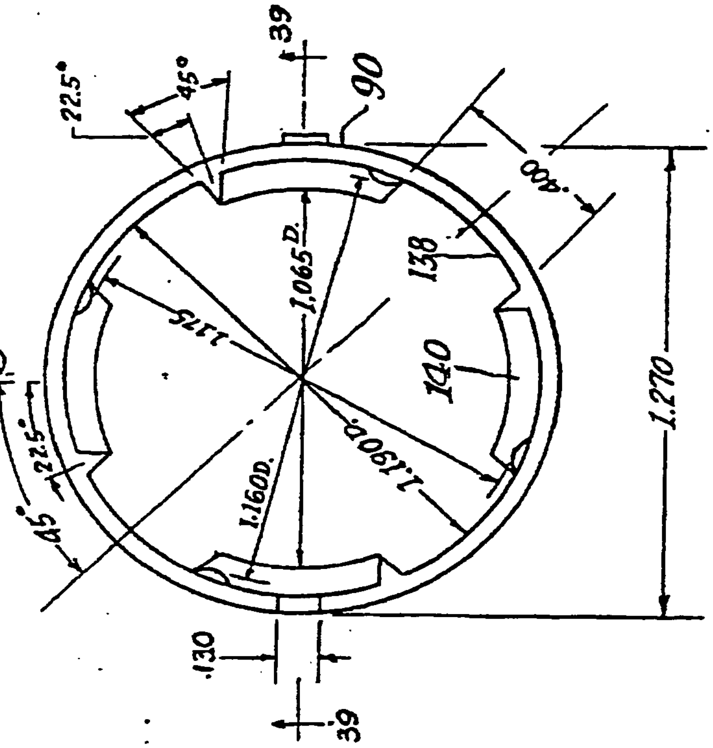


Fig. 38.

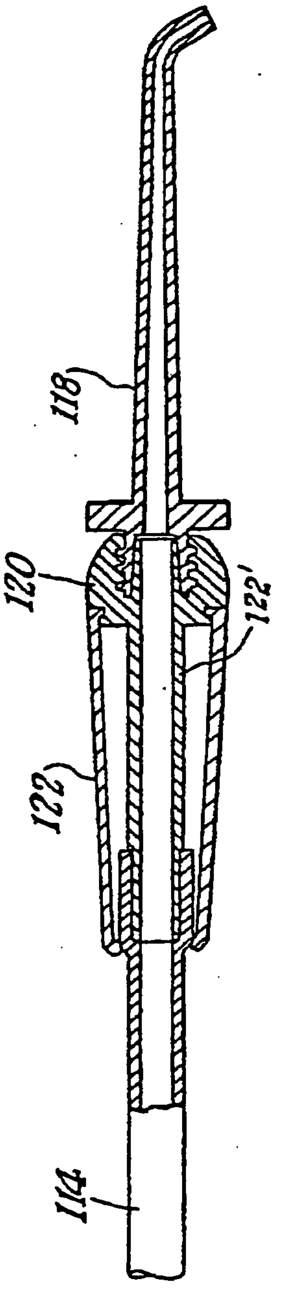


Fig. 37.

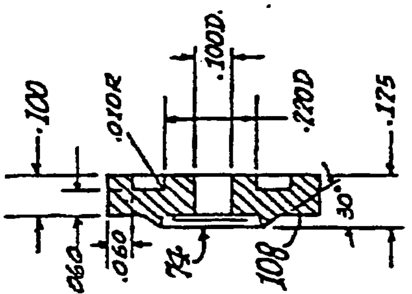


Fig. 34.

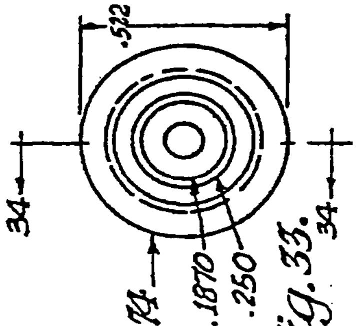


Fig. 33.

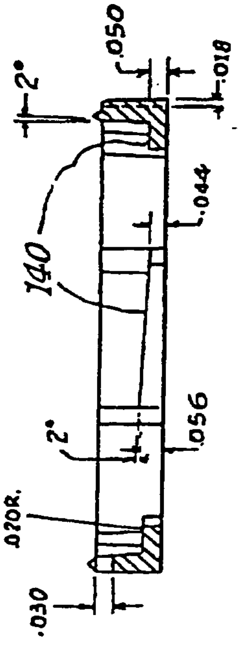


Fig. 39.

BUREAU

INTERNATIONAL SEARCH REPORT

International Application No PCT/US81/00155

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL.3 F16K 31/383

U.S. CL. 137/624.14

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	137/624.A

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	US, A 2,229,829 PUBLISHED 28 JANUARY 1941	1-12
X	US, A 3,910,303 PUBLISHED 07 JUNE 1974	

* Special categories of cited documents: [15]

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2] 26 MARCH 1981	Date of Mailing of this International Search Report [2] 07 APR 1981
International Searching Authority [1] ISA/US	Signature of Authorized Officer [20]

International Application No. PCT/US81/00155

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☒ **OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE** [10]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ______, because they relate to subject matter [11] not required to be searched by this Authority, namely:

2. ☒ Claim numbers 13, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [12], specifically:

VI. ☐ **OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING** [11]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (supplemental sheet (2)) (October 1977)